Chapter 1 : Uncertainty - Wikipedia

*Reasonable Uncertainty [Gerald Priestland] on www.nxgvision.com *FREE* shipping on qualifying offers. Quakers are chary of doctrine, feeling that it seeks to limit our understanding of God and to shut people out rather than bring them in.*

View Issue Doubt has been considered essential to science since long before the scientific method was established in the 17th century. But the idea that doubt is a virtue is not without its critics. If we remind ourselves of the origins and value of each of these two views of doubt, and of the potential for both to be exploited, we will be in a better position to appropriately exercise and assess doubt in science. The process by which doubt can evolve from being viewed as virtuous to being viewed as sinful has four steps: The first three steps are well recognized and accepted in the scientific community; however, the fourth step and its negative effects on healthy scientific dialogue and self-critique has been less acknowledged. Wikimedia Commons Ad Right First, there is legitimate doubt. The value of doubt for the advancement of knowledge has been recognized and simultaneously found to be abhorrent , at least by some thinkers, since the time of Socrates. The Greek philosopher valued doubt, but his fellow Athenians tried him and ultimately put him to death, in part because of his professed ignorance. That sentiment has traveled throughout the ages and has been reaffirmed frequently by scientists and scholars. One of the best-known and most vigorous advocates for incorporating doubt into investigative thinking was Richard Feynman, who spoke passionately about inherent curiosity and the mystery of science: It becomes a habit of thought. Once acquired, one cannot retreat from it anymore. More recently, well-founded doubt unmasked the corrupt nature of the evidence purportedly suggesting that vaccines caused autism. It also led to the withdrawal of thalidomide from the market one might argue that greater doubt might have prevented its approval in the first place , and it has inspired many other efforts to increase the rigor and reproducibility of research. Although doubt is widely recognized as fundamental to the scientific method, it can also be exploited inappropriately. Notably, the guise of healthy scientific skepticism can be used to question claims that are beyond reasonable doubt, such as the following: The Earth is closer to 4. Species evolve by Darwinian selection. Smoking tobacco causally increases the risk of lung cancer. Our planet is, on average, getting warmer at least in part because of human action. Twitter Harvard University historian of science Naomi Oreskes and California Institute of Technology historian of science and technology Erik Conway wrote about such illegitimate cooption of doubt in Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming, illustrating the dangers of misrepresented and exaggerated scientific uncertainty. Doubt, they argue, is vulnerable to exploitation. The truth of that statement is well established. That stance is easily misused as a rhetorical tactic to dismiss critical scientists whose goal is better scienceâ€"and not nihilistic doubt. Indeed, Oreskes and Conway describe the essential uncertainty of science: Doubt-mongering also works because we think science is about factsâ€"cold, hard, definite facts. If someone tells us that things are uncertain, we think that means that the science is muddled. This is a mistake. There are always uncertainties in any live science, because science is a process of discoveryâ€¦ Doubt is crucial to scienceâ€"in the version we call curiosity or healthy skepticism, it drives science forwardâ€"but it also makes science vulnerable to misrepresentation. Drummed-Up Doubt The third step in the evolution of doubt is the legitimate condemnation of the illegitimate cooption of doubt. In these instances, doubt is seen as consisting solely of disingenuous expressions of skepticism, motivated by financial or other nonscientific interests, which are allowed to pervert scientific interests. Finally, this cycle all comes full circle, with some individuals illegitimately coopting the rhetoric used to condemn manufactured doubt, and using it instead to condemn reasonable doubt. Indeed, the existence and acceptance of doubt as sin and use of the accompanying rhetorical tools have paved the way for a second and illegitimate coopting of an otherwise legitimate argument. The same tools used to discredit disingenuous expressions of doubt can be used against those who express well-supported doubt. Those with particular political views may declare some doubt to be unreasonable, even if it is actually quite reasonable. And this kind of creeping doubt has the danger of discouraging scientists from checking on the reproducibility of their results. Pamela Ronald second from right , a researcher who studies genetically modified organisms, had to retract some papers because of mislabeled bacterial strains. Although she was transparent about the error, anti-GMO groups used the retractions to cast doubt on the entire field of GMO research. Sometimes, this self-regulation may lead to one of the most painful outcomes for a scientist: For instance, Pamela Ronald is a plant pathologist and geneticist at the University of California, Davis, who works on genetically modified organisms GMOs , and has long been under attack by anti-GMO groups. In the midst of this exchange, Ronald realized that her lab had erred in a few studies carried out in and , because she discovered that the results could not be replicated. The error was traced back to the mislabeling of two bacterial strains. She then wrote extensively about the entire process. Finding the error did not change her overall view on the benefits of GMOs. Her goal was to weed out erroneous results. Nonetheless, she was vilified by those opposed to GMOs. But retractions can be weaponized. Instead of being recognized as a possible outcome for any scientist, given human fallibility, they are instead used as evidence that an entire body of work or area of research is deeply flawed. The resulting attacks could be a disincentive for other researchers to be similarly forthcoming. Although some may weaponize retractions to unfairly cast doubt on an entire body of work, there are examples of more constructive dialogue between individuals with opposing views. Michael Pollan, a professor at the University of California, Berkeley, Graduate School of Journalism, who is not a defender of GMOs, invited Ronald to speak in to an audience of students and to make her case for the safety and usefulness of GMOs. Members of the press who attended the debate reported that it was contentious, but mostly courteous. The key lies in the phrases reasonable doubts and unreasonable doubts. We must resist the urge to use ad hominem arguments and instead focus on the scientific evidence. If the evidence is as multifaceted, reproducible, and consistent as it is, for example, in the case of Darwinism, then we would expect that showing the evidence should be enough. That said, whether it is enough is open to question. Other tactics beyond merely presenting the evidence may help scientists make their points more effectively, but if these points are extrascientific, does their introduction by scientists undermine the true basis for the epistemic authority of scientists qua scientists? When citizens and scientists fail to heed facts and well-reproduced studies, we may find ourselves thinking that unreasonable doubt is tantamount to denialism. Even then, though, we should resist the use of rhetorical devices that dismiss doubt as sinful and rely on extrascientific reasoning, regardless of how effective such tactics may be. Indeed, recent research by James Weatherall at the University of California, Irvine, and his colleagues suggests that ad hominem arguments can have as much influence on patterns of thought as do arguments that are critical of empirical data. Other fallacious arguments may be even more effective. For example, comedian John Oliver may have meant well on his television show Last Week Tonight in when he had 97 people march on stage in white lab coats to represent the 97 percent of scientists who have concluded that global warming is occurring and that human action contributes to it. But in doing so, he switched from evidence-based argument to argumentum ad verecundiam or argumentum ad populum. The reliance on these tactics invites the use of similar nonscientific reasoning in situations where the evidence in doubt is not as multifaceted, reproducible, and consistent as it is for a subject such as climate change or evolution. Such tactics make for entertaining television, but they are not a useful template for scientific discourse. We must resist the urge to use ad hominem arguments, and instead focus on the scientific evidence. Public health specialist Sara E. Gorman suggest that individuals are physiologically rewarded when they filter out contradictory information and focus on information that confirms existing beliefs. Even if nonscientific rhetorical devices lead to short-term gains in silencing the merchants of doubt, such advantages may be outweighed by the long-term disadvantages of normalizing ad hominem attacks and other tactics as part of the scientific discourse. Utilitarianism would advise against the use by scientists of persuasive tactics other than those that are evidence-based. There truly are peopleâ€"some of them in positions of authorityâ€"who are promoting disingenuous and unreasonable expressions of doubt. However, if we slip and rely on nonscientific rhetorical devices to argue against them, then we invite others to use these rhetorical devices to dismiss cases in which scientific doubt is reasonable and even essential. As scientists and scholars, we need to rise above that, stick to the science, and never give up the virtue of doubt. The Seven Deadly Sins of Psychology: Denying to the Grave: The anatomy of a retraction. Scientific American Food Matters blog, October Experimental method and spontaneous generation: The controversy between Pasteur and Pouchet, â€” Journal of the History of Medicine and Allied Sciences How to beat science and influence people: Policy makers and propaganda in epistemic networks.

DOWNLOAD PDF REASONABLE UNCERTAINTY

Chapter 2 : Idealism vs. reasonable uncertainty

"Reasonable scientific certainty" holds no currency in the scientific community. The National Commission on Forensic Science was a federal body created in to address conflicts of professional culture between the law and the sciences.

In order for two values to be consistent within the uncertainties, one should lie within the range of the other. What if there are several measurements of the same quantity? Joe is making banana cream pie. The recipe calls for exactly 16 ounces of mashed banana. Joe mashes three bananas, then puts the bowl of pulp onto a scale. After subtracting the weight of the bowl, he finds a value of Not satisified with this answer, he makes several more measurements, removing the bowl from the scale and replacing it between each measurement. Strangely enough, the values he reads from the scale are slightly different each time: There are two ways he can describe the scatter in his measurements. The mean deviation from the mean is the sum of the absolute values of the differences between each measurement and the average, divided by the number of measurements: Can Joe use his mashed banana to make the pie? Well, based on his measurements, he estimates that the true weight of his bowlful is using mean deviation from the mean How can one estimate the uncertainty of a slope on a graph? If one has more than a few points on a graph, one should calculate the uncertainty in the slope as follows. In the picture below, the data points are shown by small, filled, black circles; each datum has error bars to indicate the uncertainty in each measurement. The hollow triangles represent points used to calculate slopes. Notice how I picked points near the ends of the lines to calculate the slopes! Draw the "best" line through all the points, taking into account the error bars. Measure the slope of this line. Draw the "min" line -- the one with as small a slope as you think reasonable taking into account error bars , while still doing a fair job of representing all the data. Draw the "max" line -- the one with as large a slope as you think reasonable taking into account error bars , while still doing a fair job of representing all the data. Calculate the uncertainty in the slope as one-half of the difference between max and min slopes. This work is licensed under a Creative Commons License.

Chapter 3 : How to Manage Uncertainty | Personal Excellence

Reasonable Uncertainty: The Limits and Expectations of an Expert's Testimony. Originally published in Forensic Magazine September , Powered by Blogger.

United Kingdom February 9 Introduction In commercial contracts it is common to come across clauses which require a party to use "best endeavours", "reasonable endeavours" or "all reasonable endeavours". It is not always clear what the difference between these interchangeable terms are, and even with a substantial body of case law dealing with these clauses there remains a certain level of uncertainty around interpreting them. This note sets out the factors that should be considered when drafting or reviewing such clauses. Types The three most common types of these clauses are best endeavours, reasonable endeavours and all reasonable endeavours. The courts have taken the approach that they can be classified as follows: This has long been recognised as the most onerous obligation without making it an absolute condition. It is still therefore subject to reasonableness. The obligor must take all steps within their power to achieve the objective even if that would involve sustaining substantial losses but probably not so as to ruin their business ; All reasonable endeavours: This is seen as the middle ground between best and reasonable endeavours. There is the least certainty over the precise meaning of the application of this type of clause. Whilst most often interpret it as the middle ground it has also been interpreted as closer to best endeavours in that all reasonable options must be taken. Whether or not the obligor is expected to sustain losses to achieve the objective under that particular clause depends on the nature and terms of the agreement, but subject to the obligor not having to prejudice its commercial interests; and Reasonable endeavours: This type of clause is the least onerous and only places an obligation on the obligor to make at least one reasonable effort to meet the objective. The obligor can consider its own interests and whether a particular action could cause it a loss. In the recent case of Astor Management AG and another v Atlaya Mining plc and others "Astor" where the requirements are unclear, the court may impose its own interpretation as to what is required. In most cases the courts will try to give legal effect to contractual provisions despite very-wide or open-ended language. An endeavours clause will only be deemed unenforceable if it, or part of it, is legally or practically impossible. This shows an increasing willingness to enforce contractual provisions where traditionally they may have been said to be void due to uncertainty. Practical drafting tips The level of contentious issues arising out of endeavours clauses means particular care should be taken to avoid uncertainty when drafting such clauses. Remember that whilst the three most commonly used endeavours clauses have acquired a certain prima facie meaning, it is important to note that each clause will be interpreted looking at the contract as a whole and the overall commercial context. If you can avoid uncertainty, aim to set out in the contract particular steps that the obligor is, or is not, expected to carry out to satisfy the particular endeavours obligation such as, whether an obligor must bear any costs or incur any expenditure in seeking to comply with the endeavours clause and, if so, how much.

Chapter 4 : Best or reasonable endeavours: Uncertainty in drafting - Lexology

Idealism vs. reasonable uncertainty. Reality is messy. Really messy. There no black or white other than what we perceive. Yet seeing things in absolute terms makes life so much easier. There are good people and bad people. Religious or scientific texts are believed to be absolutely true. We listen to others and are sure we know just what they mean.

Uncertainty quantification and Uncertainty propagation The most commonly used procedure for calculating measurement uncertainty is described in the "Guide to the Expression of Uncertainty in Measurement" GUM published by ISO. The uncertainty of the result of a measurement generally consists of several components. The components are regarded as random variables , and may be grouped into two categories according to the method used to estimate their numerical values: Type A, those evaluated by statistical methods Type B, those evaluated by other means, e. The simplest form is the standard deviation of a repeated observation. In metereology , physics , and engineering , the uncertainty or margin of error of a measurement, when explicitly stated, is given by a range of values likely to enclose the true value. This may be denoted by error bars on a graph, or by the following notations: The precision is symmetric around the last digit. Thus it is understood that The numbers in parenthesis apply to the numeral left of themselves, and are not part of that number, but part of a notation of uncertainty. They apply to the least significant digits. This can occur when using a logarithmic scale, for example. Uncertainty of a measurement can be determined by repeating a measurement to arrive at an estimate of the standard deviation of the values. Then, any single value has an uncertainty equal to the standard deviation. However, if the values are averaged, then the mean measurement value has a much smaller uncertainty, equal to the standard error of the mean, which is the standard deviation divided by the square root of the number of measurements. This procedure neglects systematic errors , however. For example, it is likely that for If the width of the interval is doubled, then probably only 4. These values follow from the properties of the normal distribution , and they apply only if the measurement process produces normally distributed errors. In that case, the quoted standard errors are easily converted to The lower the accuracy and precision of an instrument, the larger the measurement uncertainty is. Notice that precision is often determined as the standard deviation of the repeated measures of a given value, namely using the same method described above to assess measurement uncertainty. However, this method is correct only when the instrument is accurate. When it is inaccurate, the uncertainty is larger than the standard deviation of the repeated measures, and it appears evident that the uncertainty does not depend only on instrumental precision. Uncertainty and the media[edit] Uncertainty in science, and science in general, may be interpreted differently in the public sphere than in the scientific community. Also, in the public realm, there are often many scientific voices giving input on a single topic. For example, global warming contrarian activists took the advice of Frank Luntz to frame global warming as an issue of scientific uncertainty, which was a precursor to the conflict frame used by journalists when reporting the issue. Journalists may inflate uncertainty making the science seem more uncertain than it really is or downplay uncertainty making the science seem more certain than it really is. Because the general public in the United States generally trusts scientists, when science stories are covered without alarm-raising cues from special interest organizations religious groups, environmental organizations, political factions, etc. In scientific modelling , in which the prediction of future events should be understood to have a range of expected values In optimization , uncertainty permits one to describe situations where the user has not full control on the final outcome of the optimization procedure, see scenario optimization and stochastic optimization. In weather forecasting , it is now commonplace to include data on the degree of uncertainty in a weather forecast. Uncertainty or error is used in science and engineering notation. Numerical values should only be expressed to those digits that are physically meaningful, which are referred to as significant figures. Uncertainty is involved in every measurement, such as measuring a distance, a temperature, etc. Similarly, uncertainty is propagated through calculations so that the calculated value has some degree of uncertainty depending upon the uncertainties of the measured values and the equation used in the calculation. In metrology , measurement uncertainty is a central concept quantifying the dispersion one may reasonably attribute to a measurement result. Such an uncertainty can also be referred to as a measurement error. In daily life, measurement uncertainty is often implicit "He is 6 feet tall" give or take a few inches , while for any serious use an explicit statement of the measurement uncertainty is necessary. The expected measurement uncertainty of many measuring instruments scales, oscilloscopes, force gages, rulers, thermometers, etc. In engineering , uncertainty can be used in the context of validation and verification of material modeling. Uncertainty is an important factor in economics. According to economist Frank Knight , it is different from risk , where there is a specific probability assigned to each outcome as when flipping a fair coin. Knightian uncertainty involves a situation that has unknown probabilities, while the estimated probabilities of possible outcomes need not add to unity. New products, services, firms and even markets may be created in the absence of probability estimates. According to entrepreneurship research, expert entrepreneurs use[when?

Chapter 5 : More Uncertainty About Reasonable Degree of Medical Certainty | Schachtman Law

It's best to use only reasonable efforts, because best efforts promises more than it can deliver. But that still leaves serious uncertainty, namely uncertainty over the magnitude of efforts required to comply with an efforts obligation.

Monday, May 21, Reasonable Uncertainty: He had backed me into a cornerâ€”or so he thought. How can you possibly testify that it is more likely than not? They are employing an unsound argument called the ecological fallacy: The National Commission on Forensic Science was a federal body created in to address conflicts of professional culture between the law and the sciences. There is no agreement among experts of the actual meaning of the phrase. Science is rarely certainâ€"it relies on statistical probability, and acknowledges that outliers can and do exist. We forensic scientists operate in a liminal space between science and law. In the past, we have had to accommodate our professional rhetoric to the demands of attorneys by accepting the use of this phrase when we testified. Why have we done so? Because the cost of rejecting this accommodation was to open ourselves to attack. An opposing lawyer would declare that we have no credibility as an expert, and the judge might dismiss our testimony as not adhering to evidentiary standards. Okay, I hear you: Dow set the federal standard for admissibility of evidence. What did the Supreme Court say is reliable? Reliable expert testimony in science and technical fields must be tested and subject to peer review, must have a known error rate, must be maintained by standards, and must be accepted by the scientific community. As a consequence of Daubert, forensic science disciplines that rely on inference and experience such as forensic pathology have been subjected to accusations of unreliability because practitioners have no published error rate and they incorporate ancillary evidenceâ€"such as information from witnesses or policeâ€"which can be inaccurately perceived as generators of cognitive bias. Our branches of science rely on training, experience, observation, and scientific inference. There is ample inferential literature to support our observations, but not enough statistics to allow us to report on our own error rate. Humility is baked into scientific semantics. There are things that are not knowable based on the current state of your field of specialty. You have to explain the limits of your science. The stakes are high. In many states, once a defendant is convicted it is not possible to appeal based on scientific advancement or factual innocence, but only on procedural grounds: The future of forensic science in the United States is in flux, and scientific literacy is becoming harder to come by in the courtroom and outside it. Nowadays one of the most daunting challenges an expert has to face is to convey uncertainty without appearing unqualified. It is an unfortunate tenet of our nature that we human beings gravitate toward the person who can exude conviction with charisma, no matter his or her actual base of experience. As individuals with integrity we have to apply rigorous scientific principles in our reports and our testimony, and we have to acknowledge that uncertainty exists. Your training and experience is reliable. Your professional opinion even when you are uncertain is reasonable. Be certain that attorneys, judges and juries get that. Judy Melinek link to: Mitchell, is now out in paperback.

Chapter 6 : Examples of Uncertainty calculations

More Uncertainty About Reasonable Degree of Medical Certainty For reasons that are not clear, the Reporters for the American Law Institute's most recent torts Restatement decided to tackle an expert witness issue, the meaning of "reasonable degree of medical certainty" (RDMC).

However, all measurements have some degree of uncertainty that may come from a variety of sources. The process of evaluating this uncertainty associated with a measurement result is often called uncertainty analysis or error analysis. The complete statement of a measured value should include an estimate of the level of confidence associated with the value. Properly reporting an experimental result along with its uncertainty allows other people to make judgements about the quality of the experiment, and it facilitates meaningful comparisons with other similar values or a theoretical prediction. Without an uncertainty estimate, it is impossible to answer the basic scientific question: When we make a measurement, we generally assume that some exact or true value exists based on how we define what is being measured. While we may never know this true value exactly, we attempt to find this ideal quantity to the best of our ability with the time and resources available. As we make measurements by different methods, or even when making multiple measurements using the same method, we may obtain slightly different results. So how do we report our findings for our best estimate of this elusive true value? The most common way to show the range of values that we believe includes the true value is: Suppose you want to find the mass of a gold ring that you would like to sell to a friend. You do not want to jeopardize your friendship, so you want to get an accurate mass of the ring in order to charge a fair market price. By simply examining the ring in your hand, you estimate the mass to be between 10 and 20 grams, but this is not a very precise estimate. After some searching, you find an electronic balance which gives a mass reading of Suppose you use the same electronic balance and obtain several more readings: By now you may feel confident that you know the mass of this ring to the nearest hundreth of a gram, but how do you know that the true value definitely lies between Since you want to be honest, you decide to use another balance which gives a reading of This value is clearly below the range of values found on the first balance, and under normal circumstances, you might not care, but you want to be fair to your friend. So what do you do now? To help answer these questions, we should first define the terms accuracy and precision: Accuracy is the closeness of agreement between a measured value and a true or accepted value. Measurement error is the amount of inaccuracy. Precision is a measure of how well a result can be determined without reference to a theoretical or true value. It is the degree of consistency and agreement among independent measurements of the same quantity; also the reliability or reproducibility of the result. The statement of uncertainty associated with a measurement should include factors that affect both the accuracy and precision of the measurement. Unfortunately the terms error and uncertainty are often used interchangeably to describe both imprecision and inaccuracy. This usage is so common that it is impossible to avoid entirely. Whenever you encounter these terms, make sure you understand whether they refer to accuracy or precision, or both. Notice that in order to determine the accuracy of a particular measurement, we have to know the ideal, true value, which we really never do. Sometimes we have a "textbook" measured value which is known precisely, and we assume that this is our "ideal" value, and use it to estimate the accuracy of our result. Other times we know a theoretical value which is calculated from basic principles, and this also may be taken as an "ideal" value. But physics is an empirical science, which means that the theory must be validated by experiment, and not the other way around. We can escape these difficulties and retain a useful definition of accuracy by assuming that, even when we do not know the true value, we can rely on the best available accepted value with which to compare our experimental value. For our example with the gold ring, there is no accepted value with which to compare, and both measured values have the same precision, so we have no reason to believe one more than the other. The only way to assess the accuracy of the measurement is to compare with a known standard. For this situation, it may be possible to calibrate the balances with a standard mass that is accurate within a narrow tolerance and is traceable to a primary mass standard at the National Institute of Standards and Technology NIST. Calibrating the balances should eliminate the discrepancy between the readings and provide a more accurate mass measurement. Precision is often reported quantitatively by using relative or fractional uncertainty: Accuracy is often reported quantitatively by using relative error: The minus sign indicates that the measured value is less than the expected value. When analyzing experimental data, it is important that you understand the difference between precision and accuracy. Precision indicates the quality of the measurement, without any guarantee that the measurement is "correct. These concepts are directly related to random and systematic measurement errors. Types of Errors Measurement errors may be classified as either random or systematic, depending on how the measurement was obtained an instrument could cause a random error in one situation and a systematic error in another. Random errors are statistical fluctuations in either direction in the measured data due to the precision limitations of the measurement device. Random errors can be evaluated through statistical analysis and can be reduced by averaging over a large number of observations see standard error. Systematic errors are reproducible inaccuracies that are consistently in the same direction. These errors are difficult to detect and cannot be analyzed statistically. If a systematic error is identified when calibrating against a standard, the bias can be reduced by applying a correction or correction factor to compensate for the effect. Unlike random errors, systematic errors cannot be detected or reduced by increasing the number of observations. It is useful to study the types of errors that may occur, so that we may recognize them when they arise. Common sources of error in physics laboratory experiments: Incomplete definition may be systematic or random - One reason that it is impossible to make exact measurements is that the measurement is not always clearly defined. For example, if two different people measure the length of the same rope, they would probably get different results because each person may stretch the rope with a different tension. The best way to minimize definition errors is to carefully consider and specify the conditions that could affect the measurement. The best way to account for these sources of error is to brainstorm with your peers about all the factors that could possibly affect your result. This brainstorm should be done before beginning the experiment so that arrangements can be made to account for the confounding factors before taking data. Sometimes a correction can be applied to a result after taking data to account for an error that was not detected. Environmental factors systematic or random - Be aware of errors introduced by your immediate working environment. You may need to take account for or protect your experiment from vibrations, drafts, changes in temperature, electronic noise or other effects from nearby apparatus. Instrument resolution random - All instruments have finite precision that limits the ability to resolve small measurement differences. For instance, a meter stick cannot distinguish distances to a precision much better than about half of its smallest scale division 0. One of the best ways to obtain more precise measurements is to use a null difference method instead of measuring a quantity directly. Null or balance methods involve using instrumentation to measure the difference between two similar quantities, one of which is known very accurately and is adjustable. The adjustable reference quantity is varied until the difference is reduced to zero. The two quantities are then balanced and the magnitude of the unknown quantity can be found by comparison with the reference sample. With this method, problems of source instability are eliminated, and the measuring instrument can be very sensitive and does not even need a scale. Failure to calibrate or check zero of instrument systematic - Whenever possible, the calibration of an instrument should be checked before taking data. If a calibration standard is not available, the accuracy of the instrument should be checked by comparing with another instrument that is at least as precise, or by consulting the technical data provided by the manufacturer. When making a measurement with a micrometer, electronic balance, or an electrical meter, always check the zero reading first. Re-zero the instrument if possible, or measure the displacement of the zero reading from the true zero and correct any measurements accordingly. It is a good idea to check the zero reading throughout the experiment. Physical variations random - It is always wise to obtain multiple measurements over the entire range being investigated. Doing so often reveals variations that might otherwise go undetected. These variations may call for closer examination, or they may be combined to find an average value. Parallax systematic or random - This error can occur whenever there is some distance between the measuring scale and the indicator used to obtain a measurement. Instrument drift systematic - Most electronic instruments have readings that drift over time. The amount of drift is generally not a concern, but occasionally this source of error can be significant and should be considered. Lag time and hysteresis systematic - Some measuring devices require time to reach equilibrium, and taking a measurement before the instrument is stable will result in a measurement that is generally too low. The most common example is taking temperature readings with a thermometer that has not reached thermal equilibrium with its environment. A similar effect is hysteresis where the instrument readings lag behind and appear to have a "memory" effect as data are taken sequentially moving up or down through a range of values. Hysteresis is most commonly associated with materials that become magnetized when a changing magnetic field is applied. Personal errors come from carelessness, poor technique, or bias on the part of the experimenter. The experimenter may measure incorrectly, or may use poor technique in taking a measurement, or may introduce a bias into measurements by expecting and inadvertently forcing the results to agree with the expected outcome. Gross personal errors, sometimes called mistakes or blunders, should be avoided and corrected if discovered. As a rule, gross personal errors are excluded from the error analysis discussion because it is generally assumed that the experimental result was obtained by following correct procedures. The term human error should also be avoided in error analysis discussions because it is too general to be useful. Estimating Experimental Uncertainty for a Single Measurement Any measurement you make will have some uncertainty associated with it, no matter how precise your measuring tool. How do you actually determine the uncertainty, and once you know it, how do you report it? The uncertainty of a single measurement is limited by the precision and accuracy of the measuring instrument, along with any other factors that might affect the ability of the experimenter to make the measurement. In both of these cases, the uncertainty is greater than the smallest divisions marked on the measuring tool likely 1 mm and 0. Unfortunately, there is no general rule for determining the uncertainty in all measurements. The experimenter is the one who can best evaluate and quantify the uncertainty of a measurement based on all the possible factors that affect the result. Therefore, the person making the measurement has the obligation to make the best judgement possible and report the uncertainty in a way that clearly explains what the uncertainty represents: If you repeat the measurement several times and examine the variation among the measured values, you can get a better idea of the uncertainty in the period. Here are the results of 5 measurements, in seconds: Whenever possible, repeat a measurement several times and average the results. This average is the best estimate of the "true" value. The more repetitions you make of a measurement, the better this estimate will be.

Chapter 7 : Uncertainty Avoidance â€“ Clearly Cultural

All reasonable endeavours: This is seen as the middle ground between best and reasonable endeavours. There is the least certainty over the precise meaning of the application of this type of clause.

The discussion is tucked away in a comment and the accompanying note, and might easily be missed by readers interested in the restated principles of tort law. Restatement Third of Torts: There is nothing unique about the usage in torts cases; nor is there any substantive relationship between the phrase RDMC and the law of torts. For most jurisdictions, this standard will be quite novel. The inconsistency perceived by the Reporters, however, is non-existent. The standards assess two very different measures â€” one assesses the level of certainty that an expert witness possesses about an opinion that is necessary to the case, and the other assesses the overall quantity of evidence that the party with the burden of proof has presented for each element of every claim that make up his case. The two standards are not even close to measuring something that can or would conflict. The independence of the standards can easily be seen when one realizes that expert witnesses in tort cases testify about issues that carry a burden of proof of clear and convincing evidence, as is often the case for tort cases involving fraud, conspiracy, or punitive damage claims. The law of crimes typically requires proof beyond a reasonable doubt, but when expert witnesses testify about cause of death or of harm, the law does not conflate the burden of proof with the standard for expert witness certainty, and exclude experts who cannot opine about their conclusions beyond a reasonable doubt. One of the cases cited by the Reporters in their note to Comment e illustrates the error. Comment e is based upon a basic category mistake. Amy Joy Donut Shops, Pa. See also Beezer v. Pennsylvania courts have made clear that this level of certainty is more than a mere probability, and this requirement is especially important in Pennsylvania, where the reliability standard is either unclear or not confidently applied by its courts. The law of Kansas, like that of Pennsylvania, requires causation to be proven by expert testimony to a reasonable degree of medical certainty. United States, F. As the court noted in Johnston, a statistical method that attributes a greater than 50 percent probability to two events being causally related does not satisfy the reasonably certain level of proof. The RDMC standard is not the only standard that applies to expert witnesses, and there is no reason to believe that it ever was used to as the sole guarantee of adequacy of every aspect of expert witness opinion testimony. Indeed, as numerous cases have pointed out, the standards of Federal Rules of Evidence and are totally independent of witness qualifications. Some very expert expert witnesses have been precluded from testifying to dubious opinions. Comment e also suffers from a temporal incoherence. More important, making a standard of admissibility turn on the outcome of direct and cross-examination is incoherent because the opinion must be first admissible before it can be the subject of these examinations. These criticisms further reveal that the Restatement has wondered into the field of evidence and away from the subject of torts. The concern implicit in these criticisms, however, curiously suggests that physicians and scientists should not rely upon medical or scientific standards in the courtroom. First, the certainty requirement applies to all expert testimony, regardless whether proffered by the party with the burden of proof on the issue. We would also have to raise the burden on expert witnesses when they offer opinions that are essential to satisfying elements of a claim that requires more evidence than a mere preponderance. Second, expert witness opinion testimony is often based upon assumptions, which the trier of fact may find are not established or which are themselves subject to some level of uncertainty. The assignment of precise mathematical probabilities to personal, subjective beliefs is a doubtful exercise, at best. Ultimately, Comment e, to Section 28, is a frolic and detour in the law of torts. Although professionals who find themselves on the witness stand may not recognize the legalistic locution of RDMC, they immediately recognize that there are some opinions that are not sufficiently strongly to act upon in a professional context. The courts that impose a RDMC standard similarly recognize that the mere conjunction of expertise and opinion is an insufficient warrant to permit a jury to receive the opinion. This entry was posted on Monday, December 27th, at 1: You can follow any responses to this entry through the RSS 2. Responses are currently closed, but you can trackback from your own site.

Chapter 8 : Reasonable Uncertainty: The Limits and Expectations of an Expertâ€™s Testimony

Recording Uncertainty in Measured Values However, there are other factors we must consider when deciding what a reasonable range of uncertainty is. An extremely.

Do you face uncertainty in your life? How do you manage them? During our conversation, we talked about his upcoming job, which is supposed to start at the end of the month. He shared with me some uncertainty surrounding the job. Apparently, he and his potential employer have yet to agree on one important job item â€" his pay. While they had proposed a starting pay, my friend felt that it was too low and requested for a higher figure. This is highly important to him, to the extent that he will reject the job if they cannot meet his request. His potential employer said that they would revert to him in time. On one hand, they will probably agree since it is a reasonable amount. On the other hand, they may say no because they have the bargaining power. How do you manage uncertainty? There have been times in my past when I had to deal with uncertainty. After I graduated from junior college, I had to select my university course, and I only had a short period to make the decision. It was a big decision that would affect my career path, so it was crucial to make the right selection. However, since I had little knowledge of the courses and little real-life experience at that point, I felt very uncertain about which course to take. It was unnerving to make such a huge decision at such a young age, in such a short time period. When I was working in my previous job, there was a point when I wanted to change job assignments to gain exposure to a different business unit. The bureaucracy of a large organization meant that I had to wait for months before it would happen. I felt great uncertainty as it was unclear when the move would happen. When I quit my job to start my coaching business, I faced the most uncertainty that I had ever faced up until that point. I was also concerned that my business might never succeed. In each instance, I learned to manage the uncertainty rather than let it overwhelm me. In the end, I pushed through the obstacles and turned each problem around, eventually achieving my goal. Uncertainty can be managed by taking the right approach. Here are my three best methods to manage it. What factors can you control? The beginning phase of any startup is always filled with uncertainty, and this was no different. Questions that filled my mind included: However, I knew that it was pointless to panic. I sat down and addressed my concerns. So I asked myself: PE soon gained traction and the rest was history. This was possible because I focused on what I could do, rather than get distracted by other things. I was never worried about whether X or Y would happen. I was always busy working every day on everything within my locus of control, which in turn created quick results. Shift from External to Internal Locus of Control You want to shift from an external locus of control to an internal locus of control. Advertisement An external locus of control means you perceive the environment to have more control than you over your life. For example, if you feel that the economy, the government, and other people have more control than you over your happiness and success in life, you have an external locus of control. An internal locus of control means you perceive yourself to have more control than the environment over your life. For example, if you see that you are fully responsible for your happiness and success, you have an internal locus of control. People with an internal locus of control tend to be happier and more proactive than people with an external locus of control. Focus on action, not worrying. Live your life as you would, independent of the uncertainty The second method is to live your life as you would normally, independent of the uncertainty. My client was a very successful business consultant with his own investment company. The job, if offered, would be a high profile role with a big paycheck. It would be a once-in-a-lifetime opportunity. Advertisement As my client neared the end of the stint, he felt apprehensive as the founders did not indicate any interest in hiring him long term. Despite his effort to get face time with them, the meeting kept getting postponed due to their busy schedules. What should my client do? Should he keep following up until he receives an answer on the job offer? However, he might come across too pushy, which might jeopardize his chances of being selected. Should he just wait for the founders to revert to the decision? But what if they never do? Would that be the end of his relationship with this firm? The uncertainty bothered my client a lot as he really wanted the job, to the point where he had put his personal plans on hold, in anticipation that he would get the job. So when the job offer became uncertain, it threw his life off balance. I would also build my personal brand by giving investment training and business consultations. I will now work on my goals as usual and not worry too much about the job offer, since it is, after all, unconfirmed. While he still did not receive any updates with regards to the pending job offer, he was at peace with the situation. After a couple of weeks, as fate would have it, he was offered a full-time job with Firm X with a great pay package. Bring certainty to the important things and let the other things go In every situation, there are always things that are important to you and other things that are less important. The third method is to bring certainty to the important things and let the other less important things go. You have no friends here. You have no income since you are unemployed. You have no fixed accommodation and you are merely living at a hostel at the moment. Your savings can only last you for another week. Your life is in a flux and everything is up in the air. What do you do? In the face of such great uncertainty, you should focus on stabilizing the most important areas of your life. For most people, these would be financial security and getting a fixed accommodation. For financial security, you can secure your finances first by doing some quick, odd jobs. You can also borrow money from your friends back home and return it once you get a job. The objective is to tide you over for the short term while you figure out what you want to do in the long term. You can take your time to look for a job that matches your aspirations once your short-term financial issues are addressed. With your finances in place, you can look for an accommodation. Check the classifieds, search Google, or approach the hostel owners for help. The whole travel was filled with uncertainty at every point. Throughout the 7 months, I was traveling without a specific agenda. I would move from one place to another when the situation called for it, such as when I was invited for a work engagement, when a reader or client offered to host me, or when I felt that I was ready to move on. I could be in Amsterdam today, with no plans on what I was doing next week, and suddenly depart for London via the next train. I could be in London, with the intention to stay there for six months, and suddenly book a flight to Philadelphia the next week because I was invited to speak at a conference there. Because of that, I rarely knew which country or city I would be in the next week, much less my exact accommodation. How did I manage such day-to-day uncertainty? I did it by focusing on the most important thing s at that moment, and only that. This meant that if my key concern at that moment was getting an accommodation, I would focus my energy on finding a decent accommodation that met my needs. If my key concern was getting to the next location safely, I would figure out how to do that and not worry about anything else. As for the other things, I would not concern myself with them until my immediate concerns were addressed. Of course, I was always working along the way. By adopting this approach, my seven-month travel was a lot of fun despite the day-to-day uncertainty. Final Words I hope you have found my three methods of managing uncertainty useful. Some of you may find uncertainty unnerving and resist it. Change is the constant today. When we resist change, we stay stagnant, and when we are stagnant, we are dead. We cannot innovate, we cannot change, and we cannot create in a meaningful way. It is through uncertainty that our character gets molded, and we learn some of our best lessons. Instead, focus on living in the present while tackling the obstacles. Often times, uncertainty comes hand in hand with decision making. Read my article on decision making: How to Make Hard Decisions:

DOWNLOAD PDF REASONABLE UNCERTAINTY

Chapter 9 : UNC Physics Lab Manual Uncertainty Guide

The uncertainty bothered my client a lot as he really wanted the job, to the point where he had put his personal plans on hold, in anticipation that he would get the job. So when the job offer became uncertain, it threw his life off balance.

Uncertainty in a single measurement Bob weighs himself on his bathroom scale. The smallest divisions on the scale are 1-pound marks, so the least count of the instrument is 1 pound. Bob reads his weight as closest to the pound mark. He knows his weight must be larger than Dick and Jane are acrobats. But if one tries to add together very different quantities, one ends up with a funny-looking uncertainty. For example, suppose that Dick balances on his head a flea ick! Using a pair of calipers, Dick measures the flea to have a height of 0. But wait a minute! In technical terms, the number of significant figures required to express the sum of the two heights is far more than either measurement justifies. Combining uncertainties in several quantities: She measures the length, width, and height: If the power is negative, discard the negative sign for uncertainty calculations only. In order for two values to be consistent within the uncertainties, one should lie within the range of the other. What if there are several measurements of the same quantity? Joe is making banana cream pie. The recipe calls for exactly 16 ounces of mashed banana. Joe mashes three bananas, then puts the bowl of pulp onto a scale. After subtracting the weight of the bowl, he finds a value of Not satisified with this answer, he makes several more measurements, removing the bowl from the scale and replacing it between each measurement. Strangely enough, the values he reads from the scale are slightly different each time: There are two ways he can describe the scatter in his measurements. The mean deviation from the mean is the sum of the absolute values of the differences between each measurement and the average, divided by the number of measurements: Can Joe use his mashed banana to make the pie? Well, based on his measurements, he estimates that the true weight of his bowlful is using mean deviation from the mean How can one estimate the uncertainty of a slope on a graph? If one has more than a few points on a graph, one should calculate the uncertainty in the slope as follows. In the picture below, the data points are shown by small, filled, black circles; each datum has error bars to indicate the uncertainty in each measurement. The hollow triangles represent points used to calculate slopes. Notice how I picked points near the ends of the lines to calculate the slopes! Draw the "best" line through all the points, taking into account the error bars. Measure the slope of this line. Draw the "min" line -- the one with as small a slope as you think reasonable taking into account error bars , while still doing a fair job of representing all the data. Draw the "max" line -- the one with as large a slope as you think reasonable taking into account error bars , while still doing a fair job of representing all the data. Calculate the uncertainty in the slope as one-half of the difference between max and min slopes.